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STRATEGIES FOR REDUCING ROAD TRAFFIC ACCIDENTS USING INTELLIGENT SYSTEMS

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Abstract: According to officially published data in Uzbekistan, a total of 5,895 road traffic accidents were recorded during January–September 2025. Because of these incidents, 1,303 people lost their lives over the nine-month period, while 4,592 individuals sustained injuries of varying severity. Statistical data indicate that the majority of these road traffic accidents lead to severe consequences, including fatalities or serious injuries. This article analyzes the main causes of road traffic accidents in the country, highlights modern technologies aimed at reducing and preventing them, and examines advanced international practices in this field..

Keywords words and phrases: speed, accident, victims, traffic accidents, infrastructure, GIS, road signs, hot spots, curb, ramp, technology, emergency braking system, hazards, caution.

INTRODUCTION

A significant proportion of road traffic accidents in our country occur near populated areas, and the majority of casualties are also recorded in these locations. This has led to increased interest in analyzing accident rates in urban environments. Identifying the factors influencing traffic accidents, understanding their causes, and determining preventive measures are of great importance.

In recent years, various measures have been implemented in our country to reduce road traffic accidents. However, despite these efforts, it is still difficult to speak of significant positive results in this regard. Unfortunately, some drivers continue to violate traffic rules.

In such circumstances, some specialists and experts propose strengthening penalties. However, it is not easy to achieve the main objective through this approach alone. Indeed, unless a high level of legal awareness and responsibility is developed among all road users, it will remain impossible to effectively prevent road traffic accidents [1].

The analysis of the current situation also confirms this trend. According to data from the Road Traffic Safety Service under the Public Security Department of the Ministry of Internal Affairs of Uzbekistan, 51.4% of recorded road traffic accidents occurred due to subjective factors, that is, as a result of drivers' negligence and failure to comply with traffic rules. During January–September 2025, a total of 5,895 road traffic accidents resulted in 1,303 fatalities and 4,592 injuries.

The analysis of conducted studies indicates that one of the main reasons for the increase in road traffic accidents is the absence of sufficiently effective deterrent mechanisms in the current legislation for traffic violations, as well as the lack of inevitability of punishment.

This situation demonstrates that ensuring road safety cannot rely solely on technical and infrastructural measures; it also requires substantial improvement of legal mechanisms. In particular, the insufficient effectiveness of penalties for traffic violations, weak preventive control, and the lack of a fully developed systematic approach to prevention contribute to the persistence of irresponsible behavior among drivers.

In this regard, based on the experience of developed countries, it is advisable to strengthen preventive and warning-based mechanisms rather than relying primarily on punitive measures, to revise fines and sanctions in proportion to the severity of violations, and to ensure the inevitability of their enforcement. Furthermore, the use of digital monitoring tools—such as automated photo and video recording systems and intelligent monitoring platforms—can

significantly reduce the human factor and serve as an effective means of preventing road traffic accidents.

METHODOLOGY

In the cities and populated areas of the Republic of Uzbekistan, the speed limit for vehicles has been reduced from 70 km/h to 60 km/h. The reason for adopting this decision is the steady increase in the number of road traffic accidents occurring almost daily across different regions of the country, many of which unfortunately result in fatalities. Citizens are expressing concerns about the situation on the roads, the quality of transport infrastructure, and the level of awareness of traffic rules among the population, especially children and young people.

Scientific studies show that an increase in speed is directly related to both the likelihood of accidents and the severity of their consequences. For example, a 1% increase in speed leads to a 4% increase in the probability of fatal accidents and a 3% increase in the likelihood of serious accidents. In the event of a collision, the risk of pedestrian fatalities rises sharply: at a speed of 65 km/h, this probability is 4.5 times higher compared to 50 km/h. Additionally, in the case of a side impact at 65 km/h, the probability of death for drivers and passengers reaches 85%.

Reducing the average speed by just 5% can decrease fatal road traffic accidents by nearly 30%. This is because the higher the speed, the longer the stopping distance required, which increases the risk of accidents. For instance, on a dry road, a driver traveling at 70 km/h covers 18–20 meters while reacting to a situation, and requires about 47 meters to bring the vehicle to a complete stop. Other factors also influence speed-related risks, including alcohol consumption, road conditions, traffic density, and weather conditions. Therefore, alongside implementing legal speed limits, it is crucial to ensure their effective enforcement, proper road design, and the application of modern automotive technologies [2].

Today, by thoroughly studying the causes of road traffic accidents, it is possible to regulate them, reassess infrastructure facilities, and scientifically determine road signage, thereby preventing such incidents. In developed countries, GIS (Geographic Information Systems) software is used to identify locations where road traffic accidents frequently occur, and special measures are developed to reduce them. Undoubtedly, in our country as well, identifying accident-prone areas and eliminating existing problems in those locations will help prevent such incidents in the future [3].

RESULTS AND DISCUSSION

According to reports by the World Health Organization, the health of children can be safeguarded by constructing dedicated pedestrian lanes, crosswalks, and curb ramps to ensure safe and convenient movement for pedestrians. Additionally, installing speed limit signs and safe school zone indicators within a 100-meter radius of schools is recommended. Furthermore, in some countries, spending on transport infrastructure between 2019 and 2021 varied from 1% to 5% of GDP, highlighting that such investments provide a significant opportunity to build infrastructure that supports multimodal transport and ensures the safety of all road users.

These reports emphasize that investments in pedestrian infrastructure not only help reduce the number of road traffic accidents but also promote physical activity among the population, decrease environmental pollution, and improve the overall quality of urban life. In particular, pedestrian paths adapted for children, the elderly, and persons with disabilities, well-lit crossings, and digital warning systems significantly enhance safety. At the same time, the experience of developed countries demonstrates that approaches based on the “Vision Zero” principles—aimed at reducing fatalities and serious injuries in road traffic accidents to zero—yield effective results. Modern technologies, including smart traffic lights, automated speed control cameras, and AI-based traffic management systems, play a key role in this process.

As a result, the implementation of comprehensive measures and technological solutions aimed at ensuring pedestrian safety constitutes an integral part of road safety management and contributes to long-term socio-economic stability. [4].

Additionally, the World Health Organization's report indicates that the causes of road traffic accidents are largely directly related to road infrastructure.

In recent years, the automotive industry has been actively implementing new technologies aimed at improving road safety and preventing traffic accidents. From the development of self-driving vehicles to collision avoidance systems, modern cars are becoming smarter and can operate with the safety of drivers and passengers in mind.

One of the main technologies increasingly implemented in modern vehicles is the automatic emergency braking system. This system uses sensors and cameras to detect obstacles on the road and automatically applies the brakes if the driver is unable to respond to the danger. This technology significantly reduces the risk of collisions.

Another new technology aimed at preventing accidents is the lane departure warning system. Sensors and cameras monitor the vehicle's position on the road and alert the driver if there is a risk of leaving the lane. This system is particularly useful when the driver is fatigued or distracted, helping to avoid dangerous situations.

Moreover, traffic sign recognition technology is becoming widespread. Cameras and software allow the vehicle to automatically detect and interpret road signs, alerting the driver to speed limits, restrictions, and other instructions. This helps ensure compliance with traffic rules and reduces the likelihood of accidents. [5].

CONCLUSION

Despite the introduction of new technologies, it is important to emphasize that the responsibility for road safety still rests primarily with the driver. While technical solutions can help prevent certain risks, nothing can replace caution and proper driving behavior.

Overall, modern technologies aimed at preventing accidents represent a significant achievement in vehicle safety. They help reduce the risk of incidents and save countless lives. However, drivers must understand the limitations of these technologies and actively participate in ensuring road safety.

At the same time, it is essential to upgrade the country's road infrastructure using international standards and methodologies. Rapid adaptation to newly implemented methods and providing modern-level road infrastructure, as seen in global best practices, is necessary.

Therefore, the combination of technological solutions and human factors plays a critical role in ensuring road safety. Enhancing drivers' knowledge and skills, increasing their responsibility, and fostering a culture of compliance with traffic rules remain top priorities alongside technical measures. Regular public awareness campaigns, modern training programs, and improved driver retraining systems play a significant role in reducing road traffic accidents.

Furthermore, in the process of developing road infrastructure across the country, the gradual implementation of digital technologies, intelligent transport systems (ITS), and automated management and monitoring tools is advisable. Roads, intersections, and pedestrian infrastructure designed according to international standards create a safe and convenient environment for all road users.

As a result, a comprehensive approach to road safety—combining modern technologies, high-quality infrastructure, and a responsible driving culture—based on advanced international experience, will contribute to reducing road traffic accidents in our country and safeguarding human life and health.

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